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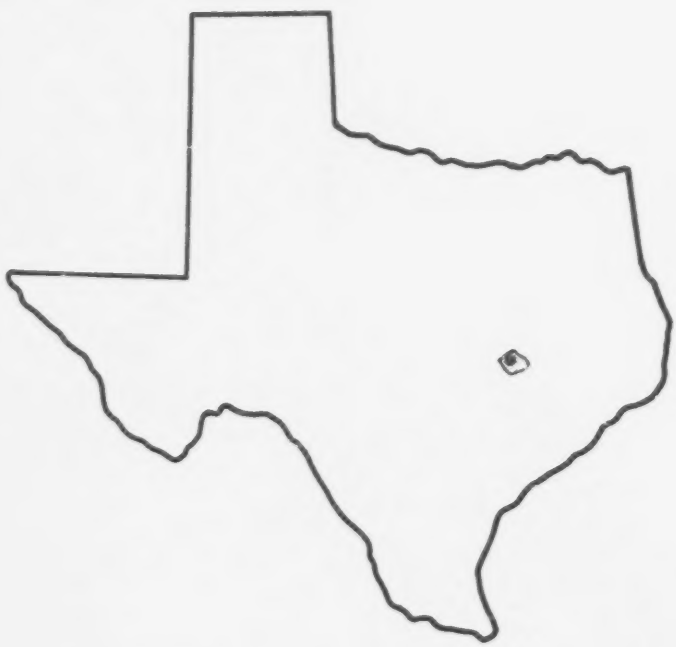
FEMA 209: 480089

FLOOD INSURANCE STUDY

CITY OF CALDWELL, TEXAS
BURLESON COUNTY



SEPTEMBER 30, 1988

Federal Emergency Management Agency

COMMUNITY NUMBER - 480089

NOTICE TO
FLOOD INSURANCE STUDY USERS

Communities participating in the National Flood Insurance Program (NFIP) have established repositories of flood hazard data for floodplain management and flood insurance purposes. This Flood Insurance Study (FIS) may not contain all data available within the repository. It is advisable to contact the community repository for any additional data.

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FLOOD INSURANCE STUDY
CITY OF CALDWELL, BURLESON COUNTY, TEXAS

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study investigates the existence and severity of flood hazards in the City of Caldwell, Burleson County, Texas, and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study has developed flood risk data for various areas of the community that will be used to establish actuarial flood insurance rates and assist the community in its efforts to promote sound floodplain management. Minimum floodplain management requirements for participation in the National Flood Insurance Program (NFIP) are set forth in the Code of Federal Regulations at 44 CFR, 60.3.

In some states or communities, floodplain management criteria or regulations may exist that are more restrictive or comprehensive than the minimum Federal requirements. In such cases, the more restrictive criteria take precedence and the state (or other jurisdictional agency) will be able to explain them.

1.2 Authority and Acknowledgments

The sources of authority for this Flood Insurance Study are the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

The hydrologic and hydraulic analyses for this study were prepared by the Soil Conservation Service (SCS) for the Federal Emergency Management Agency (FEMA), during the preparation of a Flood Plain Management Study for Burleson County. The work for that study was completed in April 1987.

1.3 Coordination

In December 1986, the City of Caldwell was notified by FEMA of the initiation of a Flood Insurance Study for the community.

On November 24, 1987, a final Consultation and Coordination Officer's (CCO) meeting was held with representatives from FEMA and the city to review the results of the study.

2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the incorporated area of the City of Caldwell, Burleson County, Texas. The area of study is shown on the Vicinity Map (Figure 1).

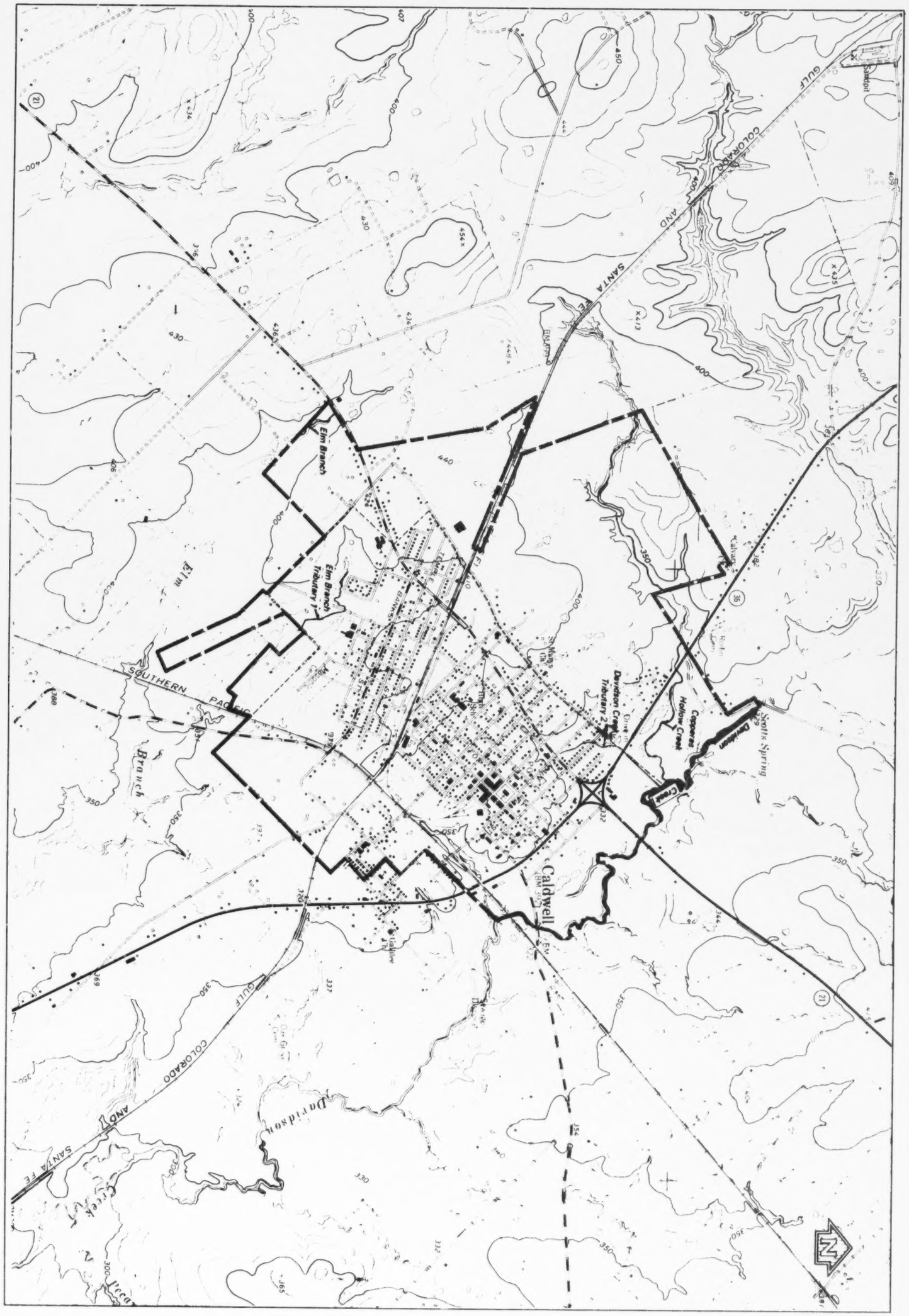


FIGURE 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF CALDWELL, TX

(BURLESON CO.)

APPROXIMATE SCALE

2000 0 2000 4000 6000 FEET

VICINITY MAP

The following streams were studied by detailed methods:

Stream	Limits of Detailed Study
Davidson Creek	from the downstream corporate limits to a point approximately 2.8 miles upstream of the confluence of Copperas Hollow Creek;
Davidson Creek Tributary 2	from its confluence with Davidson Creek to a point approximately 215 feet upstream of Hill Street;
Copperas Hollow Creek	from its confluence with Davidson Creek to a point approximately 6.8 miles upstream of State Route 36;
Elm Branch	for its entire length within the community; and
Elm Branch Tributary 1	from approximately 4 miles downstream of the corporate limits to State Route 21.

The areas studied by detailed methods were selected with priority given to all known flood hazard areas and areas of projected development and proposed construction.

2.2 Community Description

The City of Caldwell is located in Burleson County, Texas, approximately 160 miles south of Dallas, and approximately 100 miles northwest of Houston. The City of Caldwell is completely surrounded by the unincorporated areas of Burleson County. In 1980, the City of Caldwell had a population of 2,953 (Reference 1).

The city is small and is experiencing growth and expansion. Many new business buildings and a new school have recently been constructed in the city along Davidson Creek.

There are two major highways in the city. Texas State Highway 36, a major northwest-southeast artery, parallels Davidson Creek through the city. Texas State Route 21, a major southwest-northeast traffic artery, crosses Davidson Creek in the city.

2.3 Principal Flood Problems

The community is affected by flooding caused by trapped local runoff water due to poor surface drainage. Minor flooding occurs several times each year. Severe floods causing extensive damages occurred in 1921, 1965, 1969, March 1983, and in May 1983.

2.4 Flood Protection Measures

No structural flood protection measures exist in the City of Caldwell at this time.

3.0 ENGINEERING METHODS

For the flooding sources studied in detail in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Flood events of a magnitude which are expected to be equaled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for floodplain management and for flood insurance rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10, 2, 1, and 0.2 percent chance, respectively, of being equaled or exceeded during any year. Although the recurrence interval represents the long term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than 1 year are considered. For example, the risk of having a flood which equals or exceeds the 100-year flood (1 percent chance of annual exceedence) in any 50-year period is approximately 40 percent (4 in 10), and, for any 90-year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported herein reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for each flooding source studied in detail affecting the community.

The hydrologic analysis for the streams studied by detailed methods were taken from the Flood Plain Management Study for Burleson County (Reference 2). Synthetic frequency methods were used in that study. Rainfall-frequency data were obtained from Technical Paper No. 40 (Reference 3). Values greater than the 100-year frequency event were determined by extrapolation of the rainfall versus frequency graph. Peak discharge values were obtained using U. S. Geological Survey (USGS) Water Resources Investigations 77-110 Open File Report (Reference 4).

A summary of the drainage area-peak discharge relationships for the streams studied by detailed methods is shown in Table 1, "Summary of Discharges."

TABLE 1 - SUMMARY OF DISCHARGES

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
DAVIDSON CREEK					
At mile 5.8	*	9,420	16,879	20,562	28,959
At mile 9.5	*	9,392	16,837	20,515	28,896
At mile 11.7	*	9,400	16,858	20,544	28,940

*Information not available

TABLE 1 - SUMMARY OF DISCHARGES - continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
DAVIDSON CREEK TRIBUTARY 2					
At mile 1.2	*	633	1,036	1,222	1,657
At mile 2.6	*	584	956	1,127	1,527
At mile 3.5	*	403	648	759	1,022
COPPERAS HOLLOW CREEK					
At mile 3.4	*	1,202	1,993	2,363	3,226
At mile 6.3	*	979	1,611	1,904	2,592
At mile 9.2	*	817	1,339	1,579	2,149
ELM BRANCH					
At mile 11.3	*	549	878	1,028	1,384
ELM BRANCH TRIBUTARY 1					
At mile 7.0	*	611	981	1,149	1,550
At mile 8.3	*	410	647	754	1,010
At mile 9.8	*	273	424	491	653

*Information not available

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of flooding from the sources studied were carried out to provide estimates of the elevations of floods of the selected recurrence intervals.

The hydraulic analysis for the streams studied by detailed methods was taken from the Flood Plain Management Study for Burleson County (Reference 2).

Cross sections were developed using the modified slope/area method. The effects of bridges and culverts on the stream hydraulics were determined using the Bureau of Public Roads Method. Computations were made using the SCS WSP-2 computer program (Reference 5). Using the output data from this program, rating curves were developed for each cross section. These curves show the relationship between stage or elevation and discharge.

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1). For stream segments for which a floodway was computed (Section 4.2), selected cross-section locations are also shown on the Flood Insurance Rate Map (Exhibit 2).

Water-surface profiles were developed from the rating curves obtained using the SCS WSP-2 computer program and discharges were obtained using USGS Water Resources Investigations 77-110 (References 5 and 4).

The hydraulic analyses for this study were based on unobstructed flow. The flood elevations shown on the profiles are thus considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail.

All elevations are referenced to the National Geodetic Vertical Datum of 1929 (NGVD). Elevation reference marks used in this study are shown on the maps; the descriptions of the marks are presented in Elevation Reference Marks (Exhibit 3).

4.0 FLOODPLAIN MANAGEMENT APPLICATIONS

The NFIP encourages State and local governments to adopt sound floodplain management programs. Therefore, each Flood Insurance Study provides 100-year flood elevations and delineations of the 100- and 500-year floodplain boundaries and 100-year floodway to assist in developing floodplain management measures.

4.1 Floodplain Boundaries

To provide a national standard without regional discrimination, the 1 percent annual chance (100-year) flood has been adopted by FEMA as the base flood for floodplain management purposes. The 0.2 percent annual chance (500-year) flood is employed to indicate additional areas of flood risk in the community. For the streams studied in detail, the 100- and 500-year floodplain boundaries have been delineated using the flood elevations determined at each cross section. Between cross sections, the boundaries were interpolated using topographic maps at a scale of 1:24,000 with a contour interval of 10 feet (Reference 6).

The 100- and 500-year floodplain boundaries are shown on the Flood Insurance Rate Map (Exhibit 2). On this map, the 100-year floodplain boundary corresponds to the boundary of the areas of special flood hazards (Zone AE), and the 500-year floodplain boundary corresponds to the boundary of areas of moderate flood hazards. In cases where the 100- and 500-year floodplain boundaries are close together, only the 100-year floodplain boundary has been shown. Small areas within the floodplain boundaries may lie above the flood elevations but cannot be shown due to limitations of the map scale and/or lack of detailed topographic data.

4.2 Floodways

Encroachment on floodplains, such as structures and fill, reduces flood-carrying capacity, increases flood heights and velocities, and

increases flood hazards in areas beyond the encroachment itself. One aspect of floodplain management involves balancing the economic gain from floodplain development against the resulting increase in flood hazard. For purposes of the National Flood Insurance Program, a floodway is used as a tool to assist local communities in this aspect of floodplain management. Under this concept, the area of the 100-year floodplain is divided into a floodway and a floodway fringe. The floodway is the channel of a stream, plus any adjacent floodplain areas, that must be kept free of encroachment so that the 100-year flood can be carried without substantial increases in flood heights. Minimum federal standards limit such increases to 1.0 foot, provided that hazardous velocities are not produced. The floodways in this study are presented to local agencies as a minimum standard that can be adopted directly or that can be used as a basis for additional floodway studies.

The floodways presented in this study were computed for certain stream segments on the basis of equal conveyance reduction from each side of the floodplain. Floodway widths were computed at cross sections. Between cross sections, the floodway boundaries were interpolated. The results of the floodway computations are tabulated for selected cross sections (Table 2). The computed floodways are shown on the Flood Insurance Rate Map (Exhibit 2). In cases where the floodway and 100-year floodplain boundaries are either close together or collinear, only the floodway boundary is shown. Portions of the floodway widths for Davidson Creek and Copperas Hollow Creek extend beyond the corporate limits. No floodway data table has been shown for Elm Branch because there are no cross sections located within the community.

The area between the floodway and 100-year floodplain boundaries is termed the floodway fringe. The floodway fringe encompasses the portion of the floodplain that could be completely obstructed without increasing at any point. Typical relationships between the floodway and the floodway fringe and their significance to floodplain development are shown in Figure 2 .

Near the mouths of streams studied in detail, floodway computations are made without regard to flood elevations on the receiving water body. Therefore, "Without Floodway" elevations presented in Table 2 for certain downstream cross sections of Davidson Creek Tributary 2 are lower than the regulatory flood elevations in that area, which must take into account the 100-year flooding due to backwater from other sources.

5.0 INSURANCE APPLICATIONS

For flood insurance rating purposes, flood insurance zone designations are assigned to a community based on the results of the engineering analyses. The zones are as follows:

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Davidson Creek								
A	5,760[1]	851/330[3]	7,813	2.6	322.4	322.4	323.4	1.0
B	6,700[1]	925/778[3]	11,595	1.8	326.4	326.4	327.4	1.0
C	8,140[1]	1906/1078[3]	21,128	1.0	326.8	326.8	327.8	1.0
D	9,480[1]	1718/822[3]	17,839	1.2	327.0	327.0	328.0	1.0
E	11,008[1]	927/721[3]	8,595	2.4	328.3	328.3	329.3	1.0
F	11,700[1]	1365/997[3]	14,195	1.5	330.5	330.5	331.5	1.0
G	14,364[1]	1483/606[3]	12,720	1.6	331.5	331.5	332.5	1.0
H	15,928[1]	1069/93[3]	9,719	2.1	332.3	332.3	333.3	1.0
Davidson Creek Tributary 2								
A	1,160[2]	140	313	3.9	332.0	328.3[4]	329.3	1.0
B	1,770[2]	495	802	1.5	333.7	333.7	334.7	1.0
C	2,420[2]	119	201	5.6	339.9	339.9	340.9	1.0
D	2,592[2]	29	118	9.6	342.4	342.4	343.4	1.0
E	2,942[2]	34	163	5.0	346.1	346.1	347.1	1.0
F	3,122[2]	36	113	7.2	349.1	349.1	350.1	1.0
G	3,522[2]	44	174	4.4	354.1	354.1	355.1	1.0

[1]Feet above confluence of Davidson Creek Tributary 1
[2]Feet above confluence with Davidson Creek
[3]Width/width within corporate limits
[4]Elevation computed without consideration of backwater effects from Davidson Creek

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF CALDWELL, TX
(BURLESON CO.)

FLOODWAY DATA

DAVIDSON CREEK DAVIDSON CREEK TRIBUTARY 2

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Copperas Hollow Creek								
A	3,380[1]	153[3]	665	3.6	336.4	336.4	337.4	1.0
B	5,460[1]	98[3]	570	4.0	345.4	345.4	346.4	1.0
C	6,320[1]	82	465	4.1	347.8	347.8	348.8	1.0
D	8,100[1]	56	355	5.2	355.6	355.6	356.6	1.0
E	9,130[1]	52	318	5.0	361.0	361.0	362.0	1.0
Elm Branch Tributary 1								
A	7,007[2]	119	325	3.5	372.9	372.9	373.9	1.0
B	8,257[2]	30	135	5.6	381.5	381.5	382.5	1.0
C	9,067[2]	42	171	3.8	387.0	387.0	388.0	1.0
D	9,798[2]	81	203	2.4	390.7	390.7	391.7	1.0

[1]Feet above confluence with Davidson Creek
[2]Feet above confluence with Elm Branch
[3]This width extends beyond corporate limits

TABLE 2

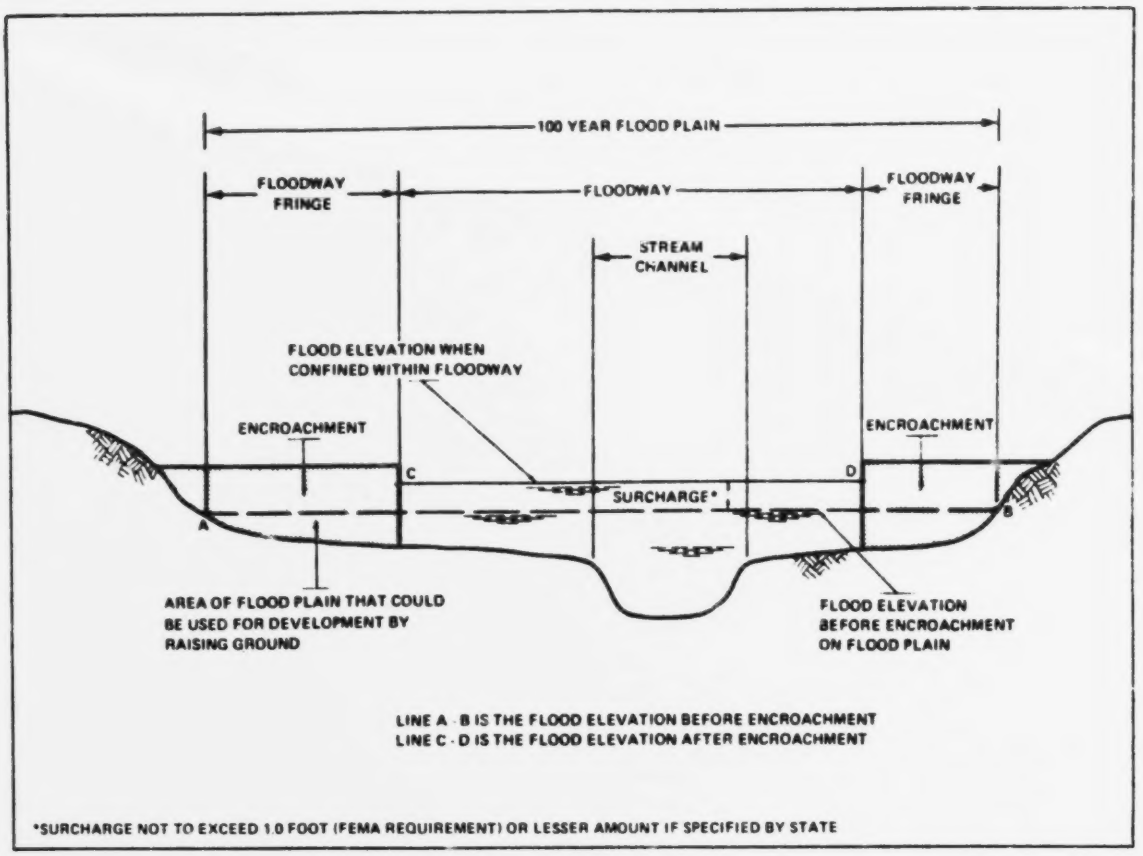
FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF CALDWELL, TX

(BURLESON CO.)

FLOODWAY DATA

COPPERAS HOLLOW CREEK, EIM BRANCH TRIBUTARY 1


100 YEAR FLOOD PLAIN
FLOODWAY FRINGE
FLOODWAY
FLOODWAY FRINGE
STREAM CHANNEL
FLOOD ELEVATION WHEN CONFINED WITHIN FLOODWAY
ENCROACHMENT
ENCROACHMENT
C
D
SURCHARGE*
A
B
AREA OF FLOOD PLAIN THAT COULD BE USED FOR DEVELOPMENT BY RAISING GROUND
FLOOD ELEVATION BEFORE ENCROACHMENT ON FLOOD PLAIN
LINE A - B IS THE FLOOD ELEVATION BEFORE ENCROACHMENT
LINE C - D IS THE FLOOD ELEVATION AFTER ENCROACHMENT
*SURCHARGE NOT TO EXCEED 1.0 FOOT (FEMA REQUIREMENT) OR LESSER AMOUNT IF SPECIFIED BY STATE

FLOODWAY SCHEMATIC Figure 2

Zone A

Zone A is the flood insurance rate zone that corresponds to the 100-year floodplains that are determined in the Flood Insurance Study by approximate methods. Because detailed hydraulic analyses are not performed for such areas, no base flood elevations or depths are shown within this zone.

Zone AE

Zone AE is the flood insurance rate zone that corresponds to the 100-year floodplains that are determined in the Flood Insurance Study by detailed methods. In most instances, whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone AH

Zone AH is the flood insurance rate zone that corresponds to the areas of 100-year shallow flooding (usually areas of ponding) where average depths are between 1 and 3 feet. Whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone AO

Zone AO is the flood insurance rate zone that corresponds to the areas of 100-year shallow flooding (usually sheet flow on sloping terrain) where average depths are between 1 and 3 feet. Average whole-depths derived from the detailed hydraulic analyses are shown within this zone.

Zone A99

Zone A99 is the flood insurance rate zone that corresponds to areas of the 100-year floodplain that will be protected by a Federal flood protection system where construction has reached specified statutory milestones. No base flood elevations or depths are shown within this zone.

Zone V

Zone V is the flood insurance rate zone that corresponds to the 100-year coastal floodplains that have additional hazards associated with storm waves. Because approximate hydraulic analyses are performed for such areas, no base flood elevations are shown within this zone.

Zone VE

Zone VE is the flood insurance rate zone that corresponds to the 100-year coastal floodplains that have additional hazards associated with storm waves. Whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone X

Zone X is the flood insurance rate zone that corresponds to areas outside the 500-year floodplain, areas within the 500-year floodplain,and to areas of 100-year flooding where average depths are less than 1 foot, areas of 10-year flooding where the contributing drainage area is less than 1 square mile, and areas protected from the 100-year flood by levees. No base flood elevations or depths are shown within this zone.

Zone D

Zone D is the flood insurance rate zone that corresponds to unstudied areas where flood hazards are undetermined, but possible.

6.0 FLOOD INSURANCE RATE MAP

The Flood Insurance Rate Map is designed for flood insurance and floodplain management applications.

For flood insurance applications, the map designates flood insurance rate zones as described in Section 5.0 and, in the 100-year floodplains that were studied by detailed methods, shows selected whole-foot base flood elevations or average depths. Insurance agents use the zones and base flood elevations in conjunction with information on structures and their contents to assign premium rates for flood insurance policies.

For floodplain management applications, the map shows by tints, screens, and symbols, the 100- and 500-year floodplains. Floodways and the locations of selected cross sections used in the hydraulic analyses and floodway computations are shown where applicable.

7.0 OTHER STUDIES

A Flood Insurance Study for the unincorporated areas of Burleson County is currently being prepared (Reference 7). The results of that study will be in agreement with the results of this study.

8.0 LOCATION OF DATA

Information concerning the pertinent data used in preparation of this study can be obtained by contacting FEMA, the Natural and Technological Hazards Division, Federal Regional Center, 800 North Loop 288, Denton, Texas 76201.

9.0 BIBLIOGRAPHY AND REFERENCES

1. U. S. Department of Commerce, Bureau of the Census, 1980 Census of Population, Number of Inhabitants, Texas, Washington, D. C., U. S. Government Printing Office, 1981.

2. U. S. Department of Agriculture, Soil Conservation Service, Flood Plain Management Study, Davidson Creek and Tributaries, Burleson County, Texas, Temple, Texas, April 1987.

3. U. S. Department of Commerce, Weather Bureau, Technical Paper No. 40, Rainfall Frequency Atlas of the United States, Washington, D. C., 1961, Revised 1963.

4. U. S. Department of the Interior, Geological Survey, Water Resources Investigations 77-110, Technique for Estimating the Magnitude and Frequency of Floods in Texas by E. E. Schroeder and B. C. Massey, Washington, D. C., 1977.

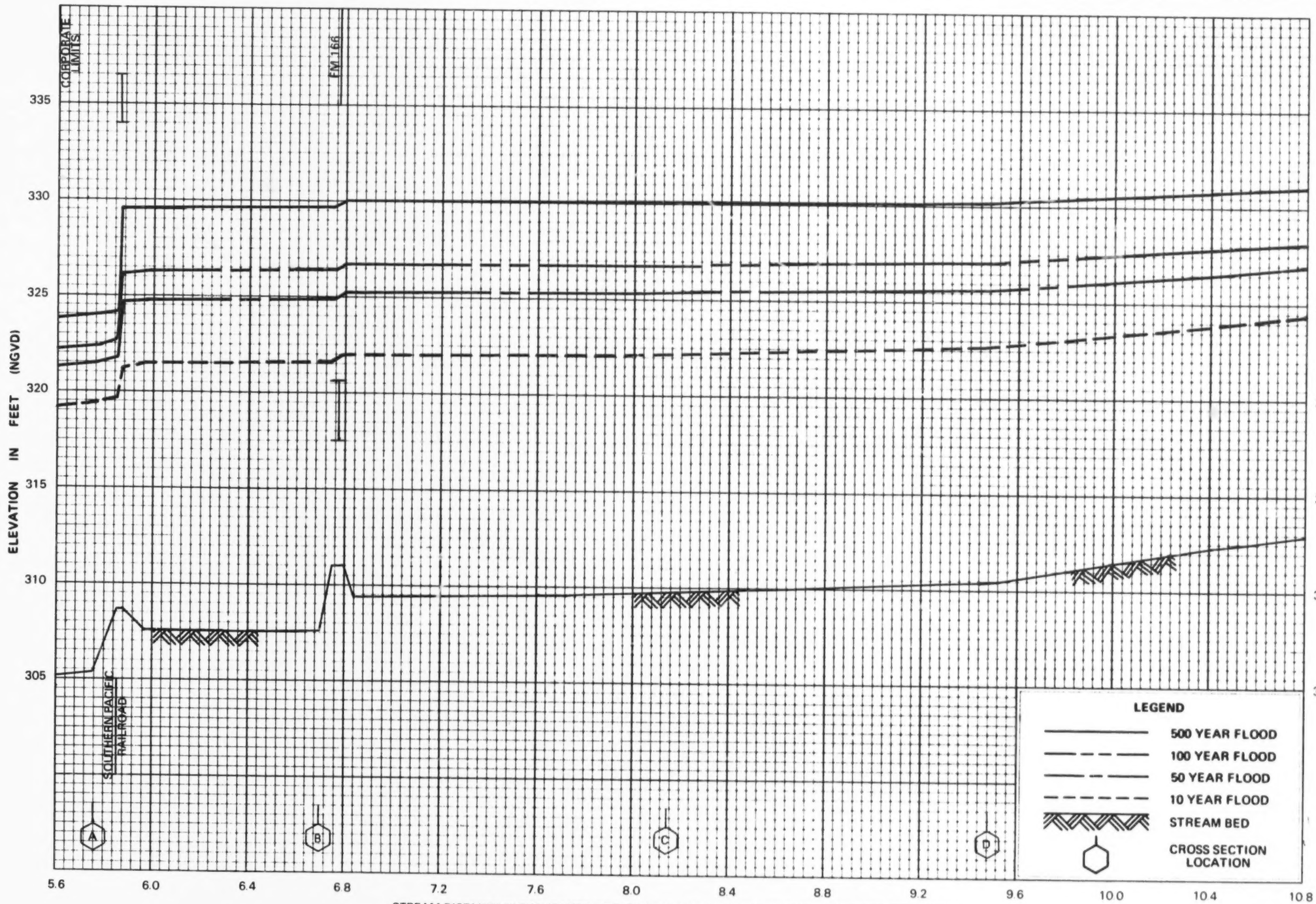
5. U. S. Department of Agriculture, Soil Conservation Service, Technical Release No. 61, WSP-2 Computer Program, Washington, D. C., May 1976.

6. U. S. Department of the Interior, Geological Survey, 7.5-Minute Series Topographic Maps, Scale 1:24,000, Contour Interval 10 Feet: Caldwell, Texas, 1961.

7. Federal Emergency Management Agency, Flood Insurance Study, Unincorporated Areas of Burleson County, Texas (Unpublished).

EXHIBIT 3 - ELEVATION REFERENCE MARKS

Reference Mark	FIRM Panel	Elevation (Feet NGVD)	Description of Location
RM 1	01	342.59	Top of fire hydrant at T-intersection of Sunny and Lewis Streets.
RM 2	02	332.28	Top of west bolt on base of street light in southeast quadrant of intersection of State Route 21 and State Route 36.
RM 3	02	343.92	Top of fire hydrant in northeast quadrant of intersection of Main Street and State Route 21.
RM 4	02	357.84	Square cut on top of south wing of west headwall at northwest corner of intersection of Alligator and North Thomas Streets.
RM 5	02	409.01	Square cut on southeast corner of concrete slab of lift station on Old San Antonio Road and Pine Drive, approximately 300 feet east of railroad.
RM 6	02	422.55	Square cut on top of southeast corner of headwall on north side of State Route 21 at intersection of State Route 21 and Hull Street.
RM 7	02	378.98	Railroad spike in centerline of west end of 8th Street, approximately 40 feet east of east bank of Elm Branch Tributary 1.



FLOOD PROFILES

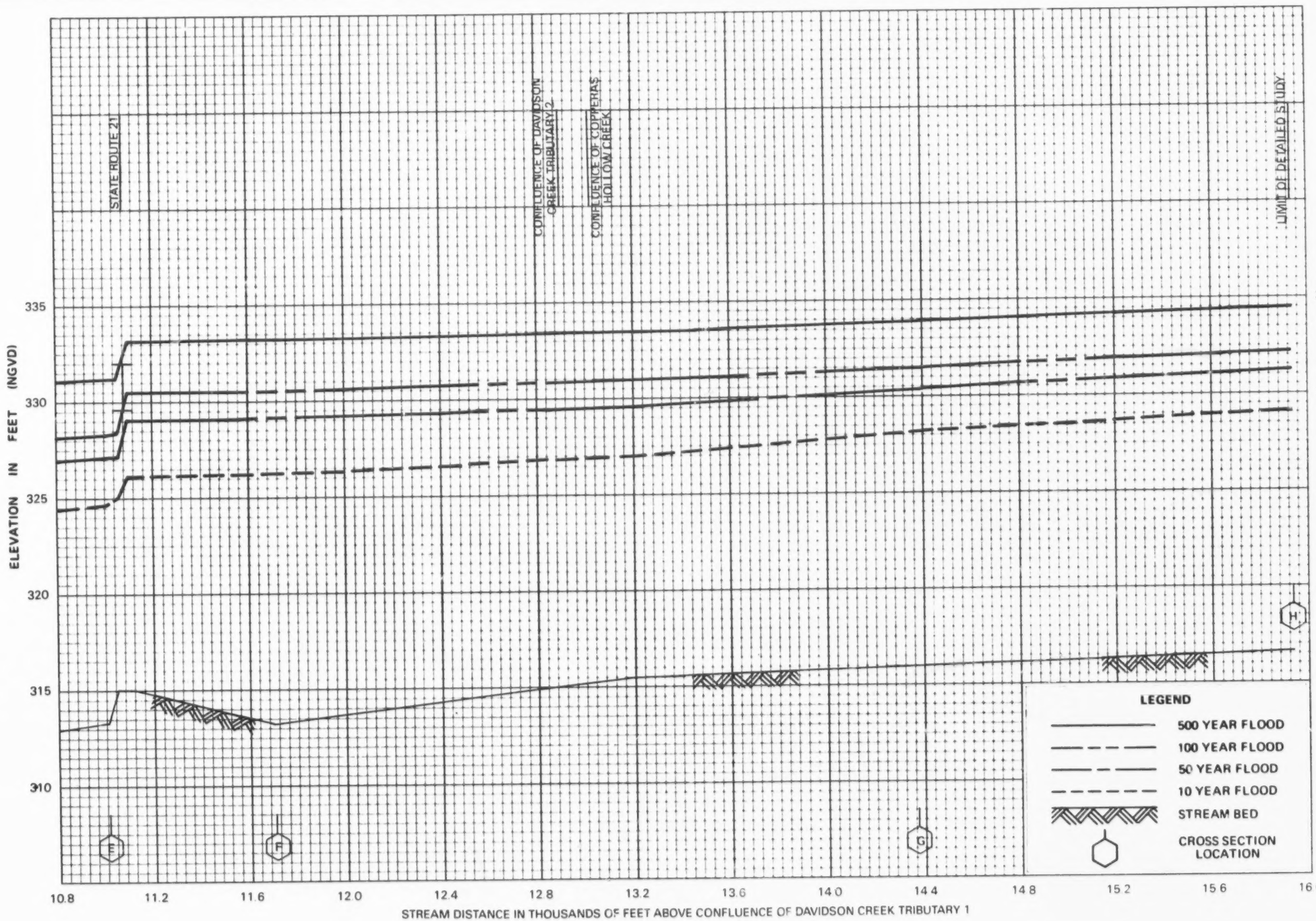
DAVIDSON CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF CALDWELL, TX

(BURLESON CO.)

01P



FLOOD PROFILES

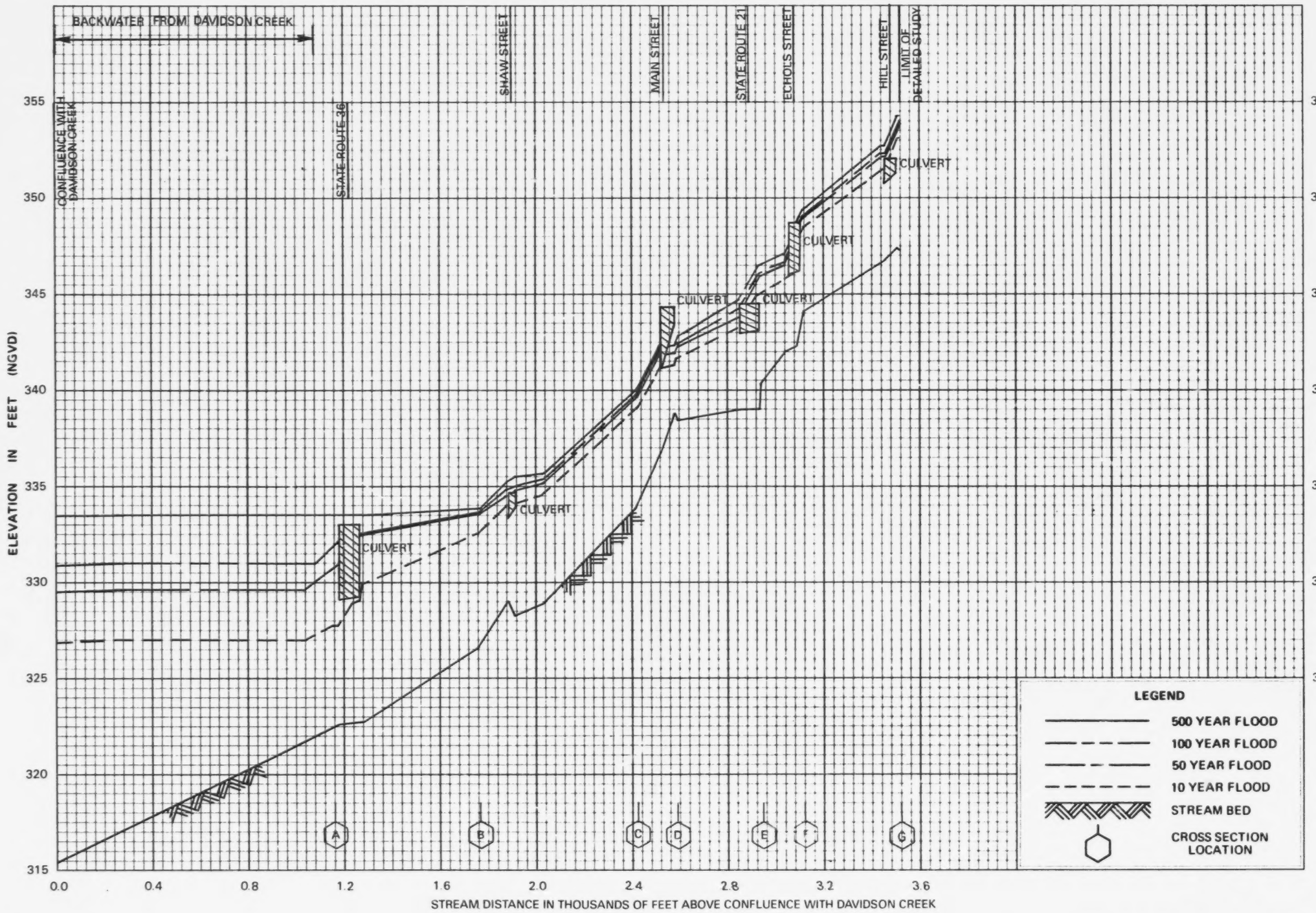
DAVIDSON CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF CALDWELL, TX

(BURLESON CO.)

02P



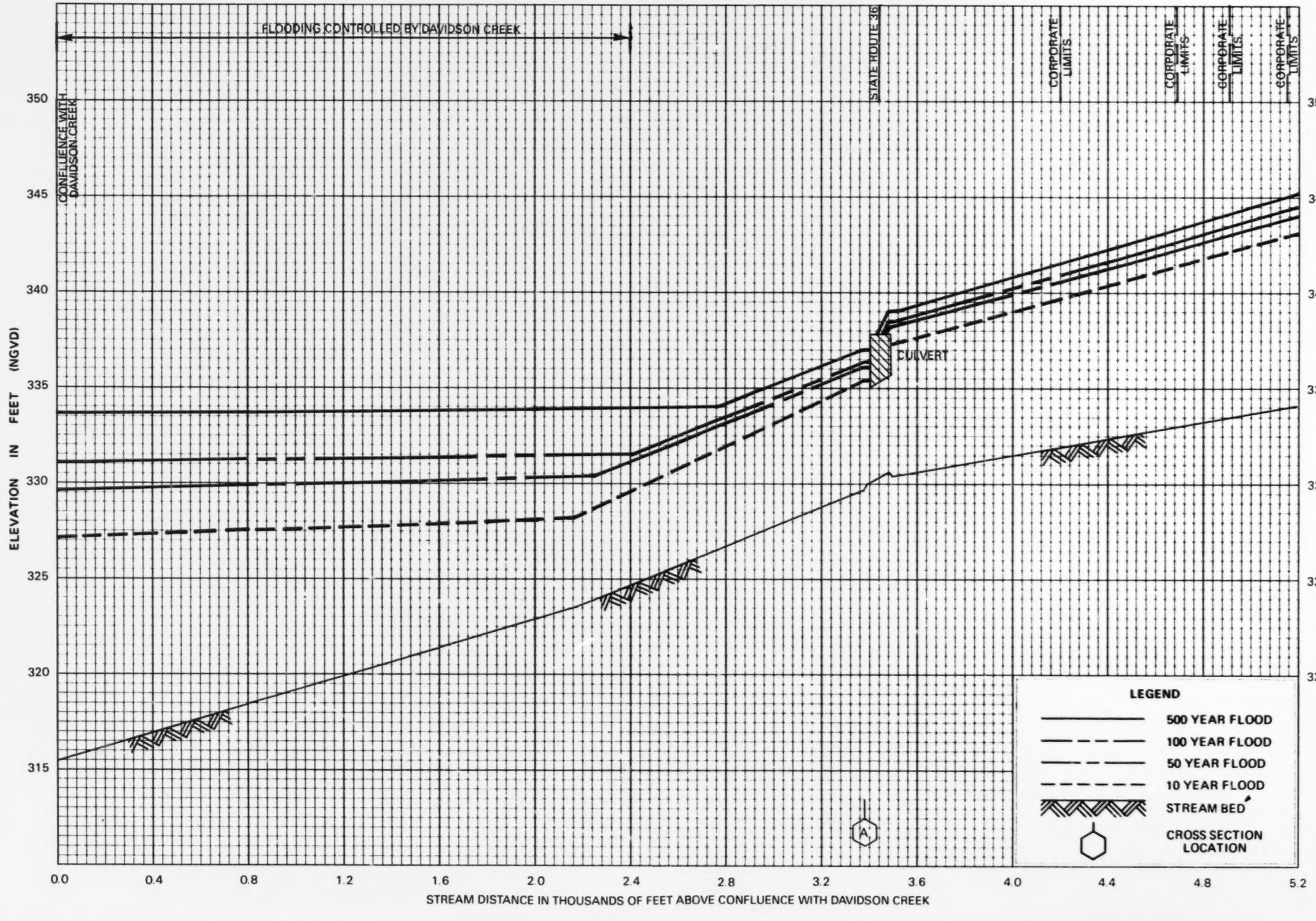
FLOOD PROFILES

DAVIDSON CREEK TRIBUTARY 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF CALDWELL, TX
(BURLESON CO.)

03P



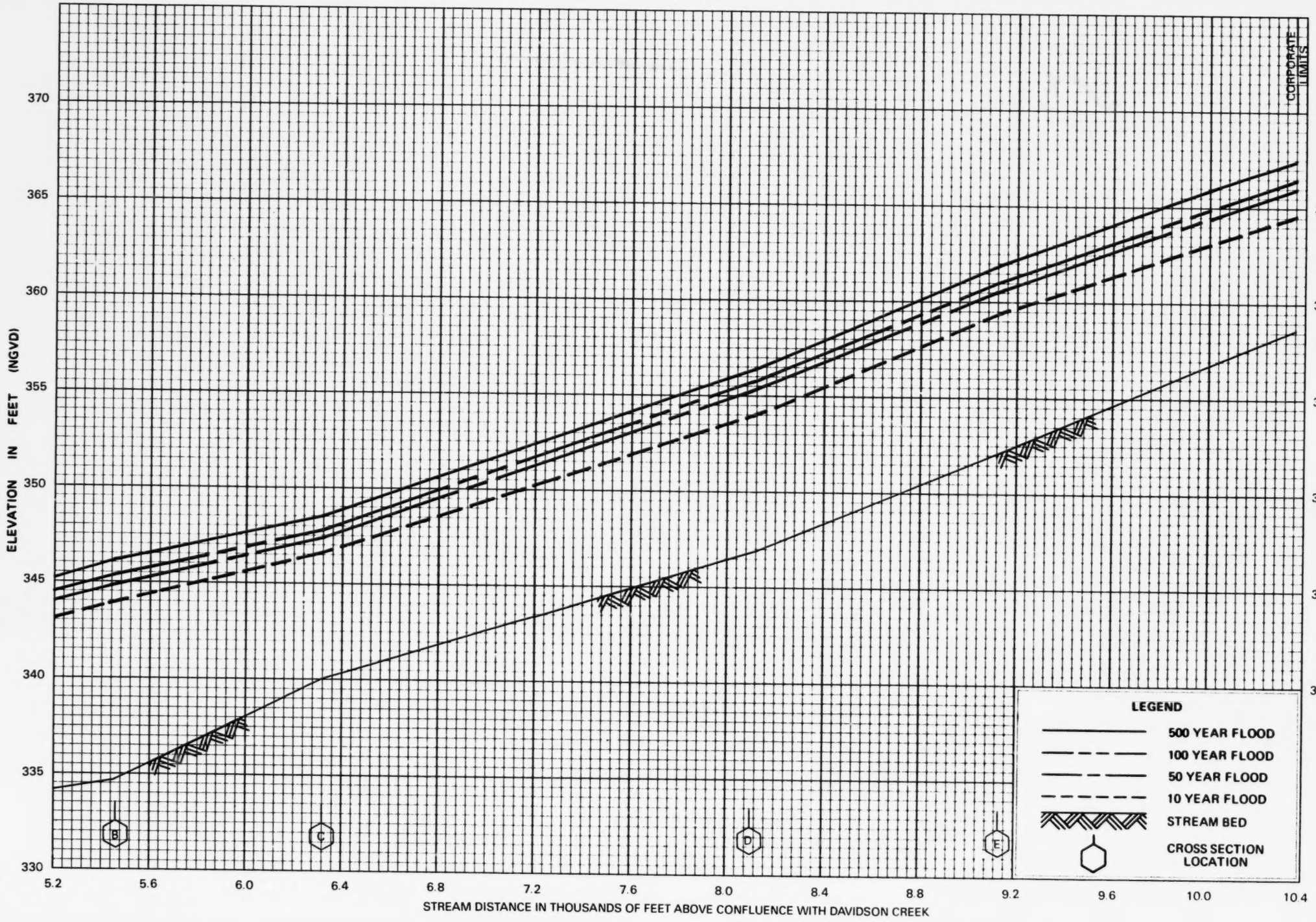
FLOOD PROFILES

COPPERAS HOLLOW CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF CALDWELL, TX
(BURLESON CO.)

04P



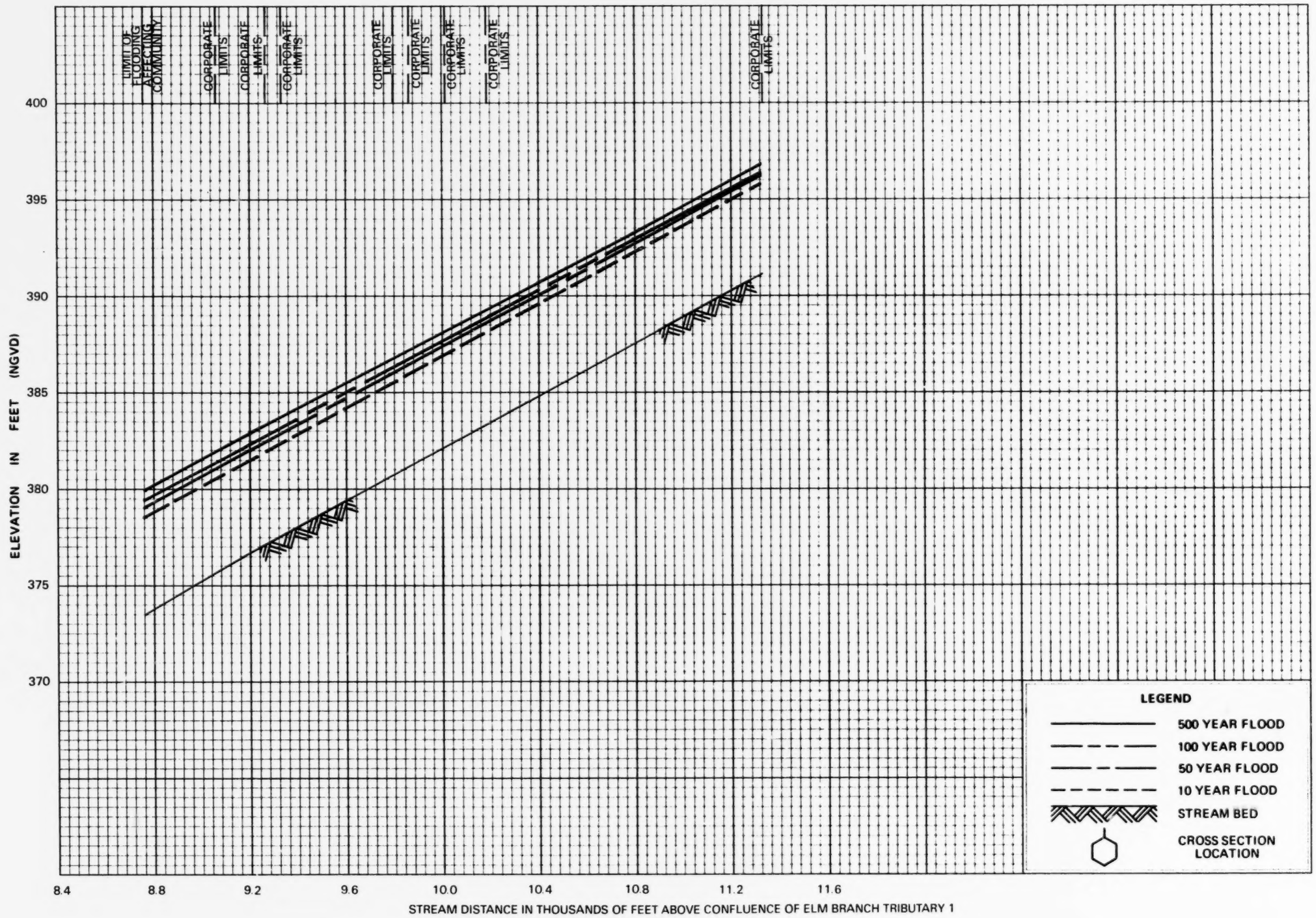
FLOOD PROFILES

COPPERAS HOLLOW CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF CALDWELL, TX
(BURLESON CO.)

05P



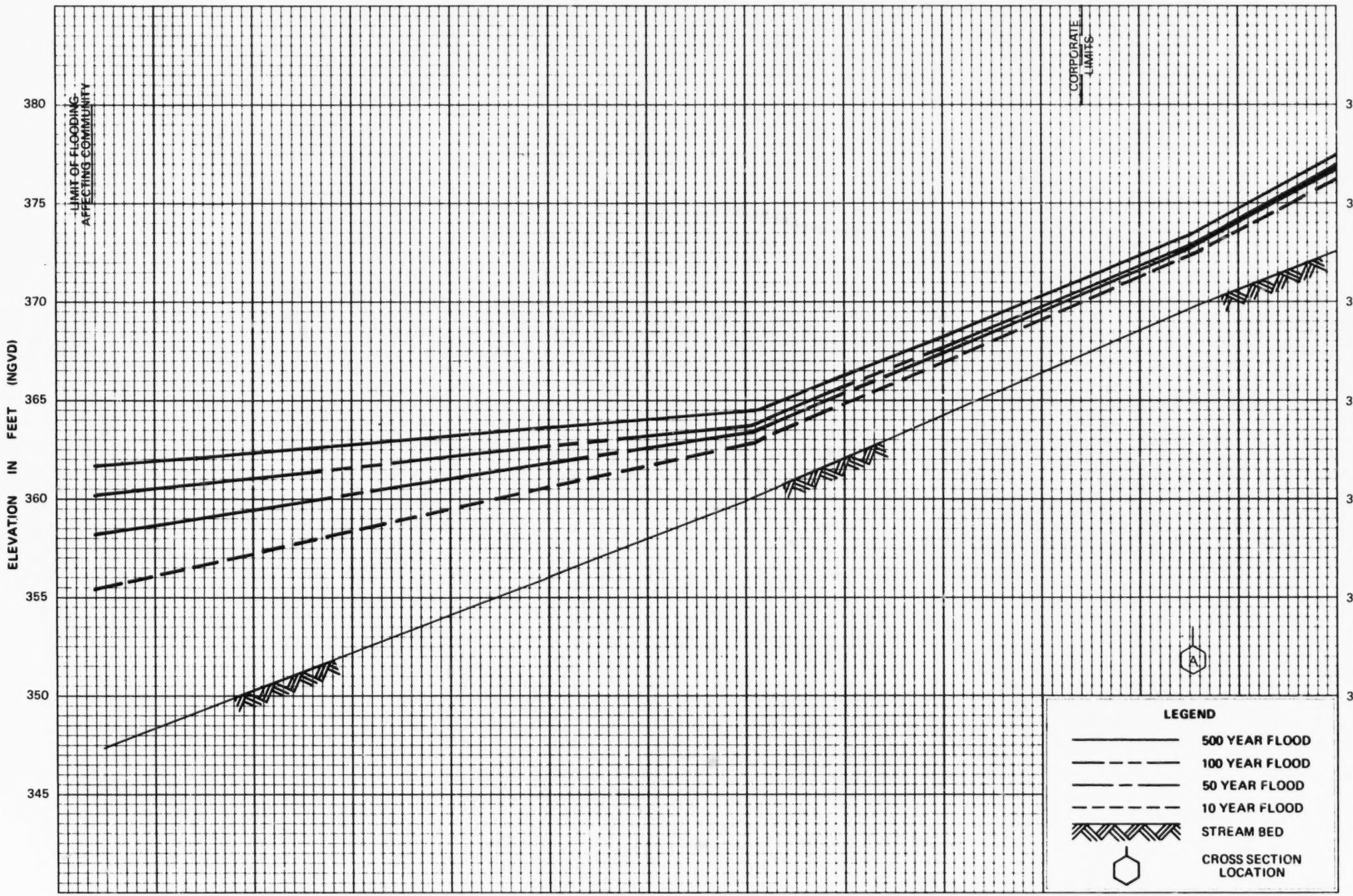
FLOOD PROFILES

ELM BRANCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF CALDWELL, TX
(BURLESON CO.)

06P



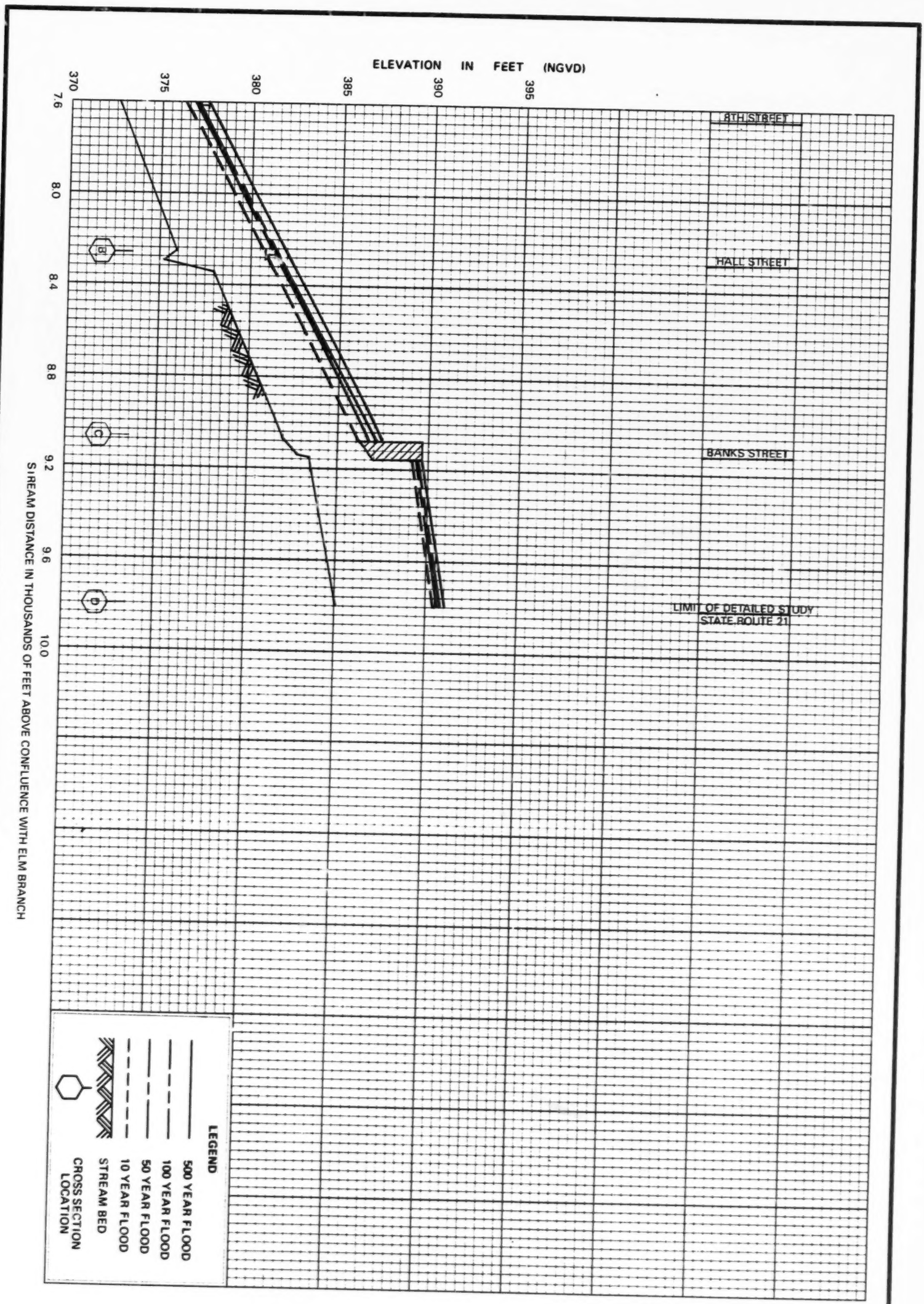
FLOOD PROFILES

ELM BRANCH TRIBUTARY 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF CALDWELL, TX
(BURLESON CO.)

07P



22

08P	FEDERAL EMERGENCY MANAGEMENT AGENCY CITY OF CALDWELL, TX (BURLESON CO.)	FLOOD PROFILES ELM BRANCH TRIBUTARY 1